SURFACE GENERATION FROM POINT CLOUDS ON SURFACE

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A surface generation method is proposed for FEM users who have to prepare a set of triangles, which can cover whole surface of arbitrary 3-dimensional domain from point clouds placed on its surface. We assume that 1) the volume to be treated is covered by smooth surface, 2) points are appropriately placed on the surface, and 3) points are also placed on feature lines where smooth sub-surfaces are connected each other.

The surface triangulation to be proposed in this paper is based on the idea that triangles covering whole surface of any 3-dimensional volume can be easily obtained by joining triangulated smooth sub-surfaces at feature lines. In order to realize this idea as a method the authors propose methods to select points on feature lines and also to generate triangles using points on smooth surface.

The proposed method consists of three main stages: The first stage is the selection of nodes on feature line and also on tips among all points on surface. Then, the residuals are points on smooth surface. This selection of points of feature lines is successfully completed by a newly proposed method, which is a modification of the method by Gumhold and et al [1].

The second stage is the triangulation of smooth sub-surface, which is surrounded by nodes on feature lines. The generation of surface triangles is based on the idea that normal vectors of all triangles surrounding a point on a smooth surface show similar direction. Then, for each point p(i) except points on feature lines and tips we select its neighbors {p(j)|j=1,m} and generate as many triangles formed by p(i) and two points among its m neighbors as possible, which show similar normal vectors. Successively, the examination of all edges of created triangles if they are used twice clarifies the necessity of additional triangulation process to cover holes on smooth surface, since any edge locate between two adjacent triangles. Then if a edge is used only in one triangle, there is a hole, which is not covered by triangles.

The third stage is to connect adjacent triangulated sub-surfaces locating both sides of a feature line one by one until all triangulated sub-surfaces are jointed together. This process is easily achieved by the points on feature lines and also on tips, which are obtained in stage 1.

The result of some test problems show that the proposed method can generate triangles on the surface of knife edges, where points on two surfaces locate very closely.

References

[1] S. Gumhold, X. Wang and R. MacLeod, “Feature extraction from point clouds”, pp.293-305, 10IMR, 2001